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PRELIMINARY RESULTS FROM CYCLE VII OF THE CATTLE GERMPLASM EVALUATION PROGRAM AT THE ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER[1]

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INTRODUCTION

Breed differences in performance characteristics are an important genetic resource for improving efficiency of beef production. Diverse breeds are required to exploit heterosis and breed complementarity through crossbreeding and development of composite populations to match genetic potential with diverse markets, feed resources and climates. Beef producers are under increasing pressure to reduce fat while maintaining or improving tenderness and palatability of products. No single breed excels in all traits of economic importance to beef production. This report presents preliminary results from Cycle VII of the Germplasm Evaluation Program at the Roman L. Hruska U.S. Meat Animal Research Center (MARC) which focused on characterization of the seven *Bos taurus* breeds that register the largest number of animals in their respective herd books. Each of the seven breeds, except Red Angus, had been characterized in earlier cycles of the Germplasm Evaluation Program as shown in Table 1. The objective of Cycle VII was to evaluate relative changes that have occurred in these breeds since they were evaluated with samples of sires born 25-30 years earlier and to provide a current evaluation of these prominent *Bos taurus* breeds.

PROCEDURES

The Germplasm Evaluation (GPE) Program has been conducted in seven cycles. Table 1 shows the mating plan for each cycle. In Cycle VII the base cows included Angus, Hereford, and composite MARC III (1/4 Angus, 1/4 Hereford, 1/4 Pinzgauer, and 1/4 Red Poll). Matings were made to produce straightbreds and reciprocal crosses of Hereford and Angus to provide estimates of heterosis to permit adjustment of means of progeny of Hereford, Angus, and Red Angus sires to heterosis expected in 3-way F1 crosses to provide unbiased comparisons to 3-way F1 crosses by Continental sire breeds. All females were four years old or older at calving. All sire breeds except Red Angus had been included in either Cycles I or II of the GPE Program (progeny born 1970-1975). In contrast to previous Cycles of the GPE Program, when only young unproven sires were sampled, about one-half of the sires sampled from each breed were among the top 50 in progeny registrations in their respective herdbooks and about one-half were young unproven sires of each breed, which was the same as in previous Cycles of the GPE Program.

Hereford and Angus. Semen from 12 Polled Hereford and nine Horned Hereford sires

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and 22 Angus sires were used to produce F1 cross progeny. Hereford and Angus sires have been used in each Cycle of the GPE Program to facilitate pooling of data and comparison of breeds in different Cycles. To provide ties for analyses pooled across cycles, six of the Hereford bulls and five of the Angus bulls had previously been used in Cycle VI of the Program. The Hereford breed registered 84,989 animals and the Angus breed registered 260, 907 animals last year (National Pedigreed Livestock Council Annual Report, 2000-2001.

Red Angus. The Red Angus breed maintains a separate Herd Book from the Angus breed. The Red Angus was established as a separate breed in 1954. The gene for red coat color is recessive to the gene for black. Some Angus carry the gene for red coat color. The foundation for the Red Angus breed was based on red segregates from the Angus breed. The Red Angus breed continues to permit introduction of red segregates from the Angus breed. Performance recording was required by the Red Angus breed since the Herd Book was established in 1954. The Red Angus breed registered 39,636 animals last year. Semen from 21 Red Angus sires was used to produce F1 cross progeny.

Charolais. The Charolais breed was developed in France as a beef breed. The breed was introduced into Mexico in the 1930's and samples were brought to the United States from Mexico in the late 1940's. With the development of a maximum security quarantine facility in Canada in the mid 1960's, large numbers of Charolais were brought to North America from France in the late 1960's and early 1970's. The Charolais breed registered 42,738 animals last year. Semen from 22 Charolais sires was used to produce F1 cross progeny.

Limousin. The Limousin breed was developed in France as a beef breed. The breed was introduced into North America via Canada in 1968. The Limousin breed registered 48,825 animals last year. Canadian registrations are included in this number. Semen from 20 Limousin sires was used to produce F1 cross progeny.

Simmental. The Simmental breed was developed in Switzerland as a dual purpose breed. Fleckvieh from Germany and Pierouge from France also contributed to Simmental in North America. The breed is used extensively in temperate climatic zones where the nutritive environment is favorable. The breed was introduced into North America via Canada in 1968. The Simmental breed registered 43,073 animals last year. Semen from 20 Simmental sires was used to produce F1 cross progeny.

Gelbvieh. The Gelbvieh breed was developed in the state of Bavaria in Germany as a dual purpose breed. The breed was introduced into North America in the early 1970's. The Gelbvieh breed registered 26,265 animals last year. Semen from 23 Gelbvieh sires was used to produce F1 cross progeny.

PROCEDURES

Management. Calves were born in March through mid-April of 1999 and 2000. Male calves were castrated within 24 hours of birth.

Data are available only on the first of two calf crops for postweaning traits.

Following a postweaning adjustment period of about 30 days, steers were assigned to replicated pens within sire breed and fed separately by sire breed for an average of 239 days. For the first 26 days following weaning a diet containing about 2.55 Mcal ME/kg dry matter and 14.25% crude protein was fed. Next, a diet containing about 2.62 Mcal ME/kg dry matter and 12.74% crude protein was fed until early December. Then a growing diet containing about 2.73 Mcal ME/kg dry matter and 11.81% crude protein was fed until early February. The finishing diet fed from about 700 lb to slaughter contained about 3.05 Mcal ME/kg dry matter and 13.1% crude protein. Steers were implanted with Synovex S (200 mg progesterone and 20 mg estradiol benzoate) in mid December and again in mid March.

Representative samples of the steers born in 1999 were slaughtered serially in 5 slaughter groups spanning 43 days (May 15, June 11, June 12, June 25, June 27). The steers were slaughtered in a commercial facility. Hot carcass weights were obtained and used to estimate dressing percent (100 x carcass weight/final live

weight). After a 36-hour chill, USDA yield grade (fat thickness, longissimus area, estimated % kidney pelvic and heart fat, carcass weight) and quality grade (marbling, maturity) data were obtained. The wholesale rib was transferred to the meat laboratory at MARC and separated into lean, fat trim, and bone. Retail product, fat trim, and bone from the right side was estimated using wholesale rib dissection prediction equations derived from steers produced previously in the GPE Program (Shackelford et al., 1995). Warner-Bratzler shear force (after 14 days postmortem aging) measures of tenderness and trained sensory panel ratings of tenderness, flavor, and juiciness were determined on cooked rib steaks.

Data Analyses. Preweaning data were analyzed by least squares mixed model procedures using a model that included a random effect for sires nested in breed of sire and the fixed effects for sire breed, dam breed, age of dam (4-5, 6-7, 8-9, ≥10 yr), year of birth, and sex of calf; interaction effects for sire breed-dam breed, and if significant, other two factor interactions; i.e., breed-sex, and sire breed-birth year. Postweaning growth and carcass data on steers were analyzed by least squares mixed model procedures using a model that included fixed effects for sire breed, dam breed, age of dam (4-5, 6-7, 8-9, ≥10 yr), and interactions of sire breed-dam breed, and random effects of sire within breed of sire, and covariates for weaning age and days fed postweaning. Data on postweaning growth and puberty traits of heifers were analyzed by least squares mixed model procedures using a model that included a random effect for sires nested in breed and fixed effects for sire breed, dam breed, year of birth, age of dam, and sire breed-dam breed. The production of straightbred Hereford and Angus and their reciprocal crosses provided for estimates of heterosis which were used in linear contrasts to adjust Hereford, Angus and Red Angus means for differences between them and the Continental breeds in expected heterosis (resulting from some straightbred matings and matings of all sire breeds with composite MARC III females which have a breed composition of 1/4 Hereford, 1/4 Angus, 1/4 Red Poll and 1/4 Pinzgauer). The average least significant difference (LSD.05) among sire breed contrasts (using sire within breed mean square as the error term) was used to access sire breed differences as large or larger than LSD.05 are expected to result from change only 5 times out of no experiment of the same magnitude.

PRELIMINARY RESULTS

Estimates of sire breed effects averaged over Hereford, Angus, and MARC III dams are shown in Table 2 for preweaning traits. Breed of sire means for postweaning growth rate and final weight of steers and some carcass traits adjusted to 448 days of age are provided in Table 3. Breed of sire means for estimates of carcass composition, and for meat tenderness and sensory traits are provided in Tables 4 and 5. Distributions for U.S.D.A. quality grade and yield grade are shown in Table 6 for British breed crosses and Table 7 for Continental breed crosses. Data for postweaning growth and carcass and meat characteristics of steers (Tables 5, 6 and 7) and for postweaning growth and puberty traits of heifers (Table 8) are especially preliminary, representing only the first of two calf crops to be evaluated in this cycle of the program. The differences shown in the tables for breed of sire, estimate one-half of the genetic differences between breeds because progeny were produced by the same dam breed groups.

Preweaning traits. Progeny of Angus and Red Angus sires had shorter gestation length than Hereford and the four Continental breeds. Among the Continental breeds, progeny of Limousin sires had the longest gestation length. Among British breeds, Hereford sired calves had greater birth weight, higher calving difficulty score, and a smaller percentage of unassisted births than Angus and Red Angus sired calves. Birth weight, calving difficulty score, and percentage of unassisted births generally did not differ between calves sired by the Hereford and the Continental breeds. Charolais topcrosses had the heaviest birth weight, highest calving difficulty score, and lowest percentage of unassisted calvings of all breed of sire groups. Differences among calves sired by the British breeds were small for 200-day weight. Limousin topcrosses were lighter at weaning than all other breed groups while Gelbvieh topcrosses were similar to those for the

British breeds. Simmental topcrosses were significantly heavier at weaning than all breed groups followed by Charolais topcrosses which were significantly heavier than Limousin, Hereford, and Red Angus topcrosses. Angus and Red Angus topcrosses were similar for all traits evaluated.

The differences between British and Continental breeds are less for unassisted calvings, calving difficulty score, and 200 day weaning weight than when they were evaluated in the early 1970's (Cycles I and II) of the GPE Program. The results indicate that British breeds have emphasized selection for growth rate relatively more than Continental breeds while Continental breeds have emphasized improvement in calving ease and reduction in birth weight relatively more than British breeds.

Postweaning growth and carcass traits of steers. Hereford, Angus, and Red Angus topcrosses were similar in postweaning average daily gain and slaughter weight adjusted to 448 days. The Limousin and Gelbvieh topcrosses were smallest and were similar to each other in postweaning average daily gain, but were not significantly different from all other breed groups. The difference between the Simmental and Limousin topcrosses approached significance in postweaning average daily gain.

Hereford, Angus, and Red Angus were similar in slaughter weight adjusted to 448 days. Limousin had smallest slaughter weight. The difference from Limousin was either significant or approached significance with all other breed groups. It is of interest to note the similarity between the average of British breeds and the average of the Continental breeds in postweaning average daily gain and slaughter weight adjusted to 448 days. The magnitudes of the differences in these traits between British and Continental breeds are considerably less than when they were evaluated in Cycles I and II of the GPE Program. These results show that the British breeds have emphasized improvement in growth rate relatively more than Continental breeds during the 25-30 year period between Cycles I and II and Cycle VII of the GPE Program.

Because of similarity of dressing percentage among all breed of sire groups, except Limousin which was significantly higher than all other breed of sire groups except Charolais, differences for carcass weights adjusted to 448 days agree with differences for slaughter weights.

Angus and Red Angus topcrosses had higher marbling scores than Hereford topcrosses. British breed topcrosses had higher marbling scores and percentage grading U.S.D.A. Choice, or higher, than Continental breed topcrosses, except Charolais which were intermediate in percentage grading U.S.D.A. Choice. Among Continental breed topcrosses, Limousin topcrosses had a lower percentage grading U.S.D.A. Choice, or higher than Charolais. Continental breed topcrosses had significantly less fat at 12th rib than the British breed topcrosses. Among British breed topcrosses, Angus topcrosses had significantly greater ribeye area than Hereford and Red Angus topcrosses and did not differ from the Continental breed topcrosses which were similar. Angus and Red Angus topcrosses were similar for all traits evaluated except ribeye area.

Carcass composition and meat tenderness. Hereford, Angus, and Red Angus topcrosses were similar in percentages and weights of estimated retail product, fat trim and bone, except Herefords had significantly greater percentages of retail product than Red Angus. Continental breed topcrosses were similar to each other in estimated percentages and weights of retail product, fat trim, and bone. The Continental breed topcrosses averaged 3.7% more retail product, 4.1% less fat trim, and .5% more bone than the British breed topcrosses.

Differences in weights of retail product, fat trim, and bone at a constant age (448 d) reflect differences in growth rates of muscle, fat, and bone tissues. Lean tissue growth rates were significantly greater for Simmental, Charolais, and Gelbvieh topcrosses (which did not differ significantly from each other) than for Hereford, Angus, and Red Angus topcrosses (which did not differ significantly from each other). Limousin topcrosses were intermediate in ranking for retail product weight at a constant age and did not differ significantly from the other Continental breeds or from Angus.

It is of interest to note that even though the British breed topcrosses have experienced

considerable change in growth rate relative to the Continental breed topcrosses since they were evaluated in 1971-1975, differences in carcass composition between British and Continental breed topcrosses at the same age are not different from what they were when sampled and characterized 30 years ago. Even though British breeds have experienced major increases in growth rate and frame size (not shown) these changes have not been accompanied by changes in carcass composition on an age constant basis. Angus and Red Angus topcrosses were similar for the traits evaluated.

Analysis of variance indicated significant variation among sire breeds in Warner Bratzler Shear and sensory estimates of tenderness but not in flavor or juiciness of longissimus steaks. Only the highest ranking breeds in shear (or lowest ranking breed for sensory tenderness), Gelbvieh or Charolais, differed significantly from the lowest ranking breed for shear (or highest ranking breed for sensory tenderness), Angus.

Quality grade and yield grade for British and Continental breed topcrosses. Differences in yield grade and carcass quality grade of British breed and Continental breed topcrosses are presented separately for each group in Tables 5 and 6. These are raw means, not adjusted by least squares procedures for disproportionate numbers among breed groups or for slaughter age. However, disproportionality in subclass numbers was not great as evidenced by the close agreement between least squares means for percentage grading U.S.D.A. Choice, or higher, (Table 3) and raw means (Tables 5 and 6) for British and Continental breed topcrosses. British breed topcrosses had steer carcasses that graded 88.8% U.S.DA. Choice, or higher, but only 23% were Yield Grade 1 and 2 while 29.8% were Yield Grade 4. Continental breed topcrosses had carcasses that graded 60.9% U.S.D.A. Choice, or higher, but 57% were Yield Grade 1 and 2 and only 4.8% were Yield Grade 4. There were no carcasses that graded U.S.D.A. Standard in this first year of the experiment. The British breed topcrosses were largely pure British breed in ancestry with Hereford, Angus and MARC III dams; MARC III is 1/4 Hereford, 1/4 Angus, 1/4 Red Poll and 1/4 Pinzgauer in breed composition. The Continental breed topcrosses had the same dams, thus they were largely one-half Continental and one-half British breed composition. For most marketing "grids", crossbred steers with a 50:50 ratio of Continental to British breed inheritance likely produce a more optimum balance between carcass quality grade and yield grade than crossbred or straightbred steers that represent either 100% British breed, or 100% Continental breeding. It is important to note that all steers were slaughtered serially over 56 day time span, to provide for evaluation of alternative age, weight and composition, end points in final analyses and reports when the experiment is completed. Thus, some steers were slaughtered earlier or later than optimum in each breed group. If fatness and weight were optimized for each individual, more favorable "grid" distribution could be achieved for each breed group; however, results to date from this and previous experiments indicate that optimum outcomes for retail product percentage, marbling and carcass weight are more easily achieved in cattle with 50:50 ratios of Continental to British inheritance than in cattle with higher or lower ratios of Continental to British inheritance.

Postweaning growth and puberty traits of heifers. Sire breeds did not differ significantly in 400-day or 550-day weights of heifers (Table 8). Results for heifers, as in steers (Table 3), indicate that differences between British and Continental sire breeds are not as great today as they were 25-30 years ago in cycle I and II of the GPE Program. Significant sire breed differences were found for height and frame scores of heifers at 550 days of age. Simmental, Charolais, and Limousin sired heifers were significantly taller than Angus and Red Angus sired heifers. Gelbvieh and Hereford sired heifers were more intermediate in height and frame score, and did not differ significantly from the higher ranking Limousin, Simmental, or Charolais sired heifers or from the lower ranking Angus and Red Angus sired heifers.

The percentage of heifers expressing their first pubertal estrus by May 7, when estrus observations were discontinued and heifers were moved from the dry-lot to grass, was significantly lower in Limousin sired heifers than in Angus or

Red Angus sired heifers. No other sire breed contrasts differed significantly in percentage expressing puberty. Sire breed differences were significant for weight and age at puberty (actual and adjusted for deviations from 100% expression of puberty by May 7). Age at puberty was significantly greater in Limousin sired heifers than in Angus or Red Angus sired heifers, but no other sire breed differed significantly for age at puberty. Sire breeds did not differ significantly for pregnancy rate.

Summary

Data are reported on 1,394 calves born in the spring of 1999 and 2000 and 1,351 calves weaned resulting from matings of Hereford, Angus, Red Angus, Simmental, Gelbvieh, Limousin, and Charolais bulls to Hereford, Angus, and composite MARC III (1/4 each Angus, Hereford, Red Poll, and Pinzgauer) cows in cycle VII of the Germplasm Evaluation Program. The calves were progeny of 20 - 23 sires of each breed, about half of which were chosen to represent the most popular sires of each breed according to recent registration numbers, and half of which were relatively young unproven herd sire prospects. Progeny of Angus and Red Angus sires had shorter gestation length, greater unassisted births, and lighter birth weights than progeny of Hereford and Charolais sires. Weaning weights were significantly heavier for Simmental, Charolais, and Gelbvieh sired progeny than for Hereford, Angus, Red Angus, and Limousin sired progeny.

Preliminary data were reported for postweaning growth and for carcass traits of 368 steers and for retail product yields, Warner-Bratzler shear, and sensory panel characteristics of 292 steers produced in 1999, the first of two calf crops to be produced in the experiment. The differences for slaughter weight and carcass weight (448 days) between progeny of Continental sire breeds compared to British sire breeds were considerably less than when they were evaluated in cycles I and II of the Germplasm Evaluation Program (1970-1974). However, differences between Continental and British breeds in retail product percentage and marbling were of about the same magnitude as they were in cycles I and II. Carcasses from progeny of Limousin, Gelbvieh, Charolais, and Simmental sires had significantly higher retail product percentages and yield grades than carcasses from progeny of Hereford, Angus, and Red Angus sires. However, marbling was significantly greater in progeny of Red Angus and Red Angus sires than in progeny of Charolais, Gelbvieh and Limousin sires. Hereford and Simmental sired progeny were intermediate in rankings for marbling and did not differ significantly from other sire breeds with higher or lower levels of marbling. Rib steaks from Angus sired progeny were significantly more tender than those from Charolais and Gelbvieh sired progeny according to both shear force and sensory panel evaluations.

Preliminary data for postweaning growth and puberty traits were reported for 365 heifers produced in 1999, the first of two calf crops to be produced in the experiment. Sire breeds did not differ significantly in heifer weights at 400 or 550 days. Hip heights and frame scores were significantly greater for heifers with Simmental, Charolais, and Limousin sires than for those with Angus and Red Angus sires. Age at puberty was significantly greater in Limousin sired heifers than in Angus or Red Angus sired heifers.

TABLE 1. SIRE BREEDS USED IN GERMPLASM EVALUATION PROGRAM AT MARC

Cycle I (1970-72)	Cycle II (1973-74)	Cycle III (1975-76)	Cycle IV (1986-90)	Cycle V (1992-94)	Cycle VI (1997-98)	Cycle VII (1999-2000)
			F_1 crosses (Hereford or Angus dams)[a]			
Hereford	Hereford	Hereford	Hereford	Hereford	Hereford	Hereford
Angus	Angus	Angus	Angus	Angus	Angus	Angus
Jersey	Red Poll	Brahman	Longhorn	Tuli	Wagyu	Red Angus
S. Devon	Braunvieh	Sahiwal	Salers	Boran	Norwegian Red	Limousin
Limousin	Gelbvieh	Pinzgauer	Galloway	Belgian Blue	Swedish Red&White	Charolais
Simmental	Maine Anjou	Tarentaise	Nellore	Brahman	Friesian	Simmental
Charolais	Chianina		Shorthorn	Piedmontese		Gelbvieh
			Piedmontese			
			Charolais			
			Gelbvieh			
			Pinzgauer			
3-way crosses out of F1 dams						
Hereford	Hereford					
Angus	Angus					
Brahman	Brangus					
Devon	Santa					
	Gertrudis					
Holstein						

[a]Composite MARC III cows (1/4 each Angus, Hereford, Red Poll and Pinzgauer) were also included in Cycles V, VI, and VII.

TABLE 2. SIRE BREED LEAST SQUARES MEANS FOR PREWEANING TRAITS OF CALVES PRODUCED IN CYCLE VII OF THE GPE PROGRAM (1999 AND 2000 CALF CROPS)

Sire breed of calf	No. calves born	Gestation length days	Calvings unassist. %	Calv. diff. score	Birth wt. lb.	Surv. to wn. %	200-d wn. wt., lb.
Hereford	190	284.3	95.6	1.24	90.4	96.2	523.9[a]
Angus	189	281.6	99.6	1.01	84.0	96.7	533.2[a]
Red Angus	206	282.1	99.1	1.06	84.5	96.7	526.3[a]
Simmental	201	285.2	97.7	1.10	92.2	96.7	553.3
Gelbvieh	209	284.4	97.8	1.10	88.7	97.1	534.0
Limousin	200	286.2	97.6	1.13	89.5	96.9	518.7
Charolais	199	283.0	92.8	1.40	93.7	97.1	540.0
LSD.05		1.5	3.4	.20	3.1	3.8	14.0

[a]Estimates for Hereford, Angus and Red Angus sires were adjusted to the level of heterosis expected in 3-way F1 crosses (10.0 lbs. was added for weaning weight) to provide for unbiased comparisons to 3-way F1 crosses by Continental sire breeds.

TABLE 3. SIRE BREED LEAST SQUARES MEANS FOR POSTWEANING GROWTH AND CARCASS TRAITS OF F1 STEERS IN CYCLE VII OF THE GPE PROGRAM (1999 CALF CROP, 448 DAYS)

Sire breed	N	Post Wn.. A.D.G. lb.	Slaughter wt, lb[a]	Carcass wt, lb[a]	Dress. %	Marb. sc	U.S.D.A Choice %	Yield grade score	Fat thick. in	Ribeye area sq. in
Hereford	50	3.46	1363	832	60.7	538	79.1	3.35	.55	12.74
Angus	59	3.40	1375	846	61.2	577	93.6	3.32	.58	13.48
Red Angus	52	3.40	1362	839	61.3	589	96.0	3.76	.60	12.21
Simmental	52	3.47	1390	854	61.4	536	61.2	2.95	.42	13.71
Gelbvieh	49	3.33	1348	826	61.3	514	63.0	2.80	.39	13.43
Limousin	53	3.30	1308	815	62.3	507	44.8	2.63	.41	14.02
Charolais	53	3.43	1370	843	61.6	517	75.7	2.77	.43	14.01
LSD.05		.18	55	33	.8	35	22.5	.41	.11	.75

[a]Estimates for Hereford, Angus, and Red Angus sires were adjusted to the level of heterosis expected in 3-way F1 crosses (estimates of 14.6 lbs. was added for slaughter weight and 13.5 lbs. was added for carcass weight) to provide for unbiased comparisons to 3-way F1 crosses by Continental sire breeds.

TABLE 4. SIRE BREED LEAST SQUARES MEANS FOR ESTIMATED RETAIL PRODUCT, TRIM, BONE YIELDS AND SHEAR FORCE OF F1 STEERS IN CYCLE VII OF THE GPE PROGRAM[a,b] (1999 CALF CROP, 448 DAYS)

Sire		Retail product		Fat trim		Bone	
breed	N	%	lb	%	lb	%	lb
Hereford	39	59.5	486	27.7	228	13.8	113
Angus	45	58.8	491	28.7	242	13.3	111
Red Angus	40	57.7	477	29.7	248	13.3	110
Simmental	41	62.1	530	24.8	212	13.9	119
Gelbvieh	40	62.3	515	24.2	200	14.4	119
Limousin	43	63.0	510	24.4	199	13.8	112
Charolais	43	62.2	526	24.9	212	13.9	118
LSD.05		1.8	24	2.1	23	.6	6

[a]Wheeler et al.
[b]Estimates from wholesale rib dissection prediction equations (Shackelford et al., 1995).

TABLE 5. SIRE BREED LEAST SQUARES MEANS FOR MEAT TENDERNESS AND SENSORY CHARACTERISTICS OF RIB STEAKS AGED FOR 14 DAYS (ADJUSTED TO AVERAGE AGE AT SLAUGHTER, 448 DAYS, 1999 CALF CROP)

		WB Shear	Sensory panel		
Sire		force[a]	Tenderness	Flavor	Juiciness
breed	No.	lb	score	score	score
Hereford	39	8.9	5.63	5.18	5.47
Angus	45	8.4	5.80	5.15	5.42
Red Angus	41	9.1	5.66	5.13	5.43
Simmental	41	8.8	5.83	5.17	5.34
Gelbvieh	40	9.8	5.30	5.02	5.32
Limousin	43	9.0	5.75	5.11	5.38
Charolais	43	9.4	5.23	4.89	5.20
LSD.05		.9	.44	.21	.21

[a]Lower shear values reflect greater tenderness.
[b]Sensory scores: 1 = extremely tough, bland, or dry through 8 = extremely tender, intense, or juicy.

TABLE 6. USDA QUALITY GRADE X YIELD GRADE DISTRIBUTIONS (%) FOR STEERS WITH HEREFORD, ANGUS AND RED ANGUS SIRES (1999 CALF CROP, N = 161)

USDA Quality grade	USDA Yield grade, %				Total
	1	2	3	4	
Low Prime	0.0	0.0	1.2	0.0	1.2
High Choice	0.0	.6	2.5	2.5	5.6
Av. Choice	0.0	1.2	9.3	3.7	14.3
Low Choice	.6	13.0	31.1	23.0	67.7
Select	0.6	6.2	2.5	1.9	11.2
Standard	0.0	0.0	0.0	0.0	0.0
Total	1.2	21.1	46.6	31.1	100.0

TABLE 7 USDA QUALITY GRADE X YIELD GRADE DISTRIBUTIONS (%) FOR STEERS WITH SIMMENTAL, GELBVIEH, LIMOUSIN, AND CHAROLAIS SIRES (1999 CALF CROP, N =207)

USDA Quality grade	USDA Yield grade, %				Total
	1	2	3	4	
Low Prime	0.0	0.0	0.0	0.0	0.0
High Choice	0.0	0.0	0.5	0.0	0.5
Av. Choice	0.5	1.5	4.3	0.0	6.3
Low Choice	3.9	26.6	21.3	2.4	54.1
Select	8.2	16.4	12.6	1.9	39.1
Standard	0.0	0.0	0.0	0.0	0.0
Total	12.6	44.4	38.7	4.4	100.0

TABLE 8. SIRE BREED LEAST SQUARES MEANS FOR GROWTH AND PUBERTY TRAITS OF HEIFERS IN CYCLE VII OF THE GPE PROGRAM (1999 CALF CROP)

Sire breed of female	No.	400-d wt. lb.	18 month wt. lb.	18 month ht. cm.	Frame score[b] sc	Puberty expressed %	Puberty wt. lb.	Age at puberty[c] Act. d	Age at puberty[c] Adj. d	Preg. rate %
Hereford	46	829	958	128.8	5.6	93.5	715	337	342	96
Angus	47	877	956	127.3	5.3	100.7	728	324	324	86
Red Angus	50	872	973	126.2	5.1	100.6	724	325	325	87
Simmental	56	848	975	130.4	6.0	99.6	742	327	328	91
Gelbvieh	62	812	938	129.3	5.7	92.4	700	317	322	78
Limousin	51	835	964	130.6	6.0	84.0	779	352	362	83
Charolais	53	830	964	129.9	5.9	89.0	728	337	344	94
LSD.05		44	48	2.3	.5	15.8	47	19	20	20

[a]Estimates for Hereford, Angus, and Red Angus were adjusted to the level of heterosis expected in 3-way F1 crosses (estimates of 23.9 lb was added for 400-d weight, and 15.0 lb was added for 550-d weight) to provide for unbiased comparisons to 3-way F1 crosses by Continental sire breeds.

[b]Frame scores were calculated from height using the equation recommended in Guidelines for Uniform Beef Improvement, Beef Improvement Federation (BIF, 1996).

[c]Actual age at puberty (ranging from 84 to 100%) and adjusted age at puberty, adjusted to remove bias due to differences in percentage expressing first estrus when observation of estrus was discontinued in early May by adding i(s) where i is the expected negative deviation from the true mean in standard deviation (s) units.